REMARKS:

Claims 1-28 are in the case and presented for consideration.

The specification was objected to for making reference to the claims in the description of the invention. Accordingly, the several paragraphs in which this type of reference was discovered have been amended to remove the improper reference.

Claims 1, 3, 4, 6, 8-12, 16, 18, and 24-28 were rejected pursuant to 35 U.S.C. §103 as made obvious by the disclosure of U.S. Patent 5,441,403 to Tanaka et al. taken alone. The remaining claims in the case were rejected as obvious from Tanaka '403 taken in combination with one of U.S. Patents 3,202,203 to Reed (claims 5, 7, 17, 19, 20), 4,453,913 to Gitman (claim 2), 5,360,171 to Yap (claims 13-15) and 6,036,476 to Mitani et al. (claims 21-23).

Independent claim 1 has been amended to more clearly recite the invention. Applicants respectfully submit that the claims 1-28 as now amended, are patentable over the cited references, taken alone or in combination with each other.

The present invention cannot be realized only by increasing a specific surface area of the combustion air flow. Additionally, it is necessary to cause the combustion air to collide with the fuel while the fuel has velocity energy which is necessary and sufficient for turbulent diffusion mixing where strong turbulences exist. In other words, in the present invention, it is necessary to bring gas in the furnace into the air jet flow by increasing the specific surface area of the combustion air flow when it is injected into the furnace. This results in sufficiently lowering the oxygen density of the combustion air, while a turbulent diffusion flame is formed for rapidly mixing the fuel jet flow with the air jet flow within a range that the fuel has velocity energy necessary and sufficient for causing the turbulent diffusing mixing involving strong turbulences. This feature of the invention is not disclosed

in any of the cited references.

Claim 1 has been amended to clearly include this feature of the invention by addition of the following limitation:

> colliding a jet flow of said fuel with said air jet flow within a range that said fuel jet flow has sufficient turbulent strength and at a position where oxygen density of said air jet flow becomes low; and rapidly mixing said fuel with said air jet flow with strong turbulences.

Independent apparatus claim 11 includes a similar limitation. This limitation, and other features of the invention are believed to distinguish the claims of the present application from the cited references.

It is conventionally thought that a flame maximum temperature can be increased and a quantity of generated NOx will also increase wherever air and fuel are caused to collide with each other when the fuel has velocity energy sufficient for causing mixing in the very strong turbulent flow state of combustion air and fuel. In particular, it has been thought that this tendency becomes most pronounced when the combustion air is preheated to a high temperature close to a combustion exhaust gas temperature and then supplied to the burner.

But, after conducting various experiments, the present inventors have discovered that, in fact, the amount of free O_2 can be reduced as low as possible and generation of soot can be suppressed while also suppressing generation of NOx when a specific surface area of an air jet flow is increased and air and fuel are caused to collide with each other in a predetermined range. That is, it has been found that it is possible to effect combustion within a range of sufficient turbulent strength and with the low oxygen density by changing

a cross sectional shape of an air jet flow and causing air and fuel to collide with each other in a predetermined range. Such a phenomenon is not conventionally known at all. In a recent low NOx burner, rapid mixing of combustion air with fuel is avoided as much as possible by making the combustion air temperature high in order to attain low NOx generation.

The action states that the Tanaka '403 patent discloses certain features of the claimed invention, including that air is directed into an air throat (9) having a plurality of air inlet openings (11) which cause air flows to collide with one another and then to be directed to a rectangular outlet. Applicants respectfully disagree. In Tanaka '403, a member having air inlet openings is used as a guide pipe for controlling a quantity and a velocity distribution of air introduced to the air throat, and is not means for forming a flat air flow in the furnace.

Moreover, in Tanaka '403, when a primary flame blows out into the furnace, a combustion air flow having high oxygen density exists in the center of the primary flame. This resulting ombustion air flow has not been used at all in the primary combustion, and the air jet flow, still having a part with high oxygen density, is formed when it collides with fuel. This combustion air flow with a high oxygen density comes into contact with a secondary fuel flow covering the primary flame and causes diffusion mixing combustion when the combustion air flow breaks through the primary flame. Therefore, even if a burner throat having a rectangular shape is employed to blow out a flat flame into the furnace, the combustion air flow loses velocity energy when coming into contact with the secondary fuel. Thus, it is not possible to involve the combustion gas in the furnace or to form strong turbulent mixing.

Instead, Tanaka '403 discloses the opposite of the present invention. That is, the invention of the Tanaka '403 patent intends to cause the secondary fuel, which is used as

a main fuel, to be brought into contact with the combustion air on the down stream side lower than the in-furnace blowing opening to the greatest extent possible. The primary flame (laminar flow diffusion flame) surrounding the whole quantity of the combustion air is formed by using a small quantity of the primary fuel. This secondary fuel is directed into the furnace from the periphery of the primary flame so as not to break the primary flame, the secondary fuel jet flow is brought into contact with the primary flame to reduce NOx generated in the primary flame, and then the secondary fuel jet flow is brought into contact, on the downstream side where the velocity energy is lost, with air escaped from the primary flame to from a gentle laminar diffusion flame. Therefore, applicants submit that the Tanaka '403 patent does not teach or suggest the present claimed invention.

Finally, the present invention is not made obvious by a combination of Tanaka '403 with the other cited references, since Tanaka '403 seeks to avoid generating a strong turbulent diffusion flame. Thus, even if Tanaka '403 is combined with the regenerative medium for preheating combustion air by exposure to exhaust gas heat of Gitman '913, with a switching means for switching air and exhaust gas of Mitani '476, or with a rectangular air outlet arranged in a line as taught by Yap '171 or even with the fuel jet flows colliding with each other as in Reed '203.

Accordingly, the application and claims are believed to be in condition for allowance, and favorable action is respectfully requested. No new matter has been added.

If any issues remain which may be resolved by telephonic communication, the Examiner is respectfully invited to contact the undersigned at the number below, if such will advance the application to allowance.

Favorable action is respectfully requested.

Respectfully submitted,

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